US011713752B2

(12) **United States Patent**
Kim et al.

(10) **Patent No.: US 11,713,752 B2**
(45) **Date of Patent: Aug. 1, 2023**

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(54) **SCROLL COMPRESSOR OF LOWER COMPRESSION TYPE ENABLING ACTIVE OIL SUPPLY**

(71) Applicant: **LG Electronics Inc.**, Seoul (KR)

(72) Inventors: **Taekyoung Kim**, Seoul (KR); **Kyungho Lee**, Seoul (KR); **Cheolhwan Kim**, Seoul (KR)

(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 269 days.

(21) Appl. No.: **17/075,198**

(22) Filed: **Oct. 20, 2020**

(65) **Prior Publication Data**

US 2021/0131412 A1 May 6, 2021

(30) **Foreign Application Priority Data**

Nov. 5, 2019 (KR) 10-2019-0140320

(51) **Int. Cl.**
F04B 27/10 (2006.01)
F04C 29/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***F04B 27/109*** (2013.01); ***F04B 39/0253*** (2013.01); ***F04C 29/025*** (2013.01); ***F04C 29/065*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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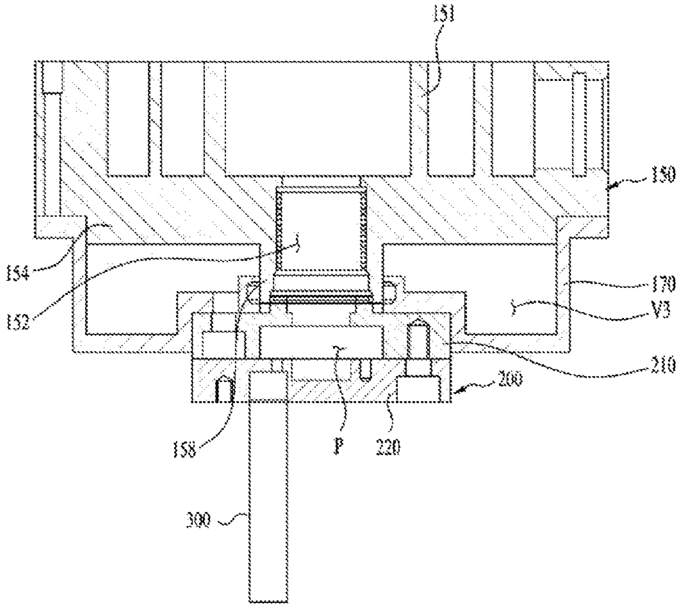
Primary Examiner — Nathan C Zollinger
Assistant Examiner — Geoffrey S Lee
(74) *Attorney, Agent, or Firm* — Fish & Richardson P.C.

(57) **ABSTRACT**

A compressor includes a driving motor, a centrifugation space, a discharge pipe, a rotary shaft, a compression portion, a pump assembly, and an oil pickup. The centrifugation space is defined inside a case by a downstream side of the driving motor and the case, and enables centrifugation of a compressed refrigerant and a lubricant oil. The discharge pipe can discharge the refrigerant from the centrifugation space outside the case. The rotary shaft is coupled to a rotor of the driving motor and defines an oil supply path. The compression portion is provided at an upstream side of the driving motor and can compress the refrigerant as the rotary shaft rotates. The pump assembly is provided below the rotary shaft and can pump oil as rotated with the rotary shaft. The oil pickup defines an oil supply path between the pump assembly and a low oil space formed inside the case.

15 Claims, 4 Drawing Sheets



(51) **Int. Cl.**

F04C 29/06	(2006.01)
F04B 39/02	(2006.01)

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FIG. 1

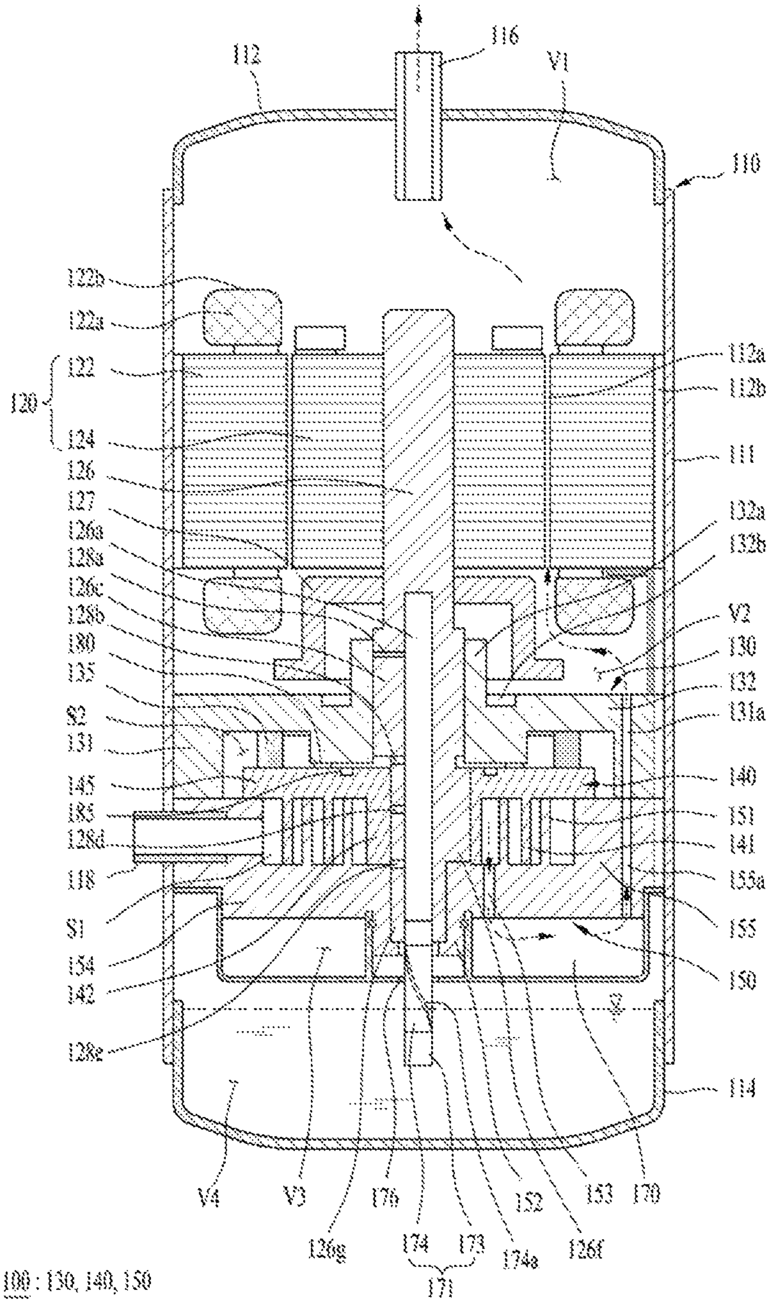

116
112
V1
110
122b
122a
120
122
124
126
127
126a
128a
126c
128b
180
135
S2
131
145
185
128d
118
S1
154
142
128e
112a
112b
111
132a
132b
V2
130
132
131a
140
151
141
155a
155
150
114
V4
V3
176
174
173
171
174a
152
126f
153
170
126g
100 : 130, 140, 150

FIG. 2

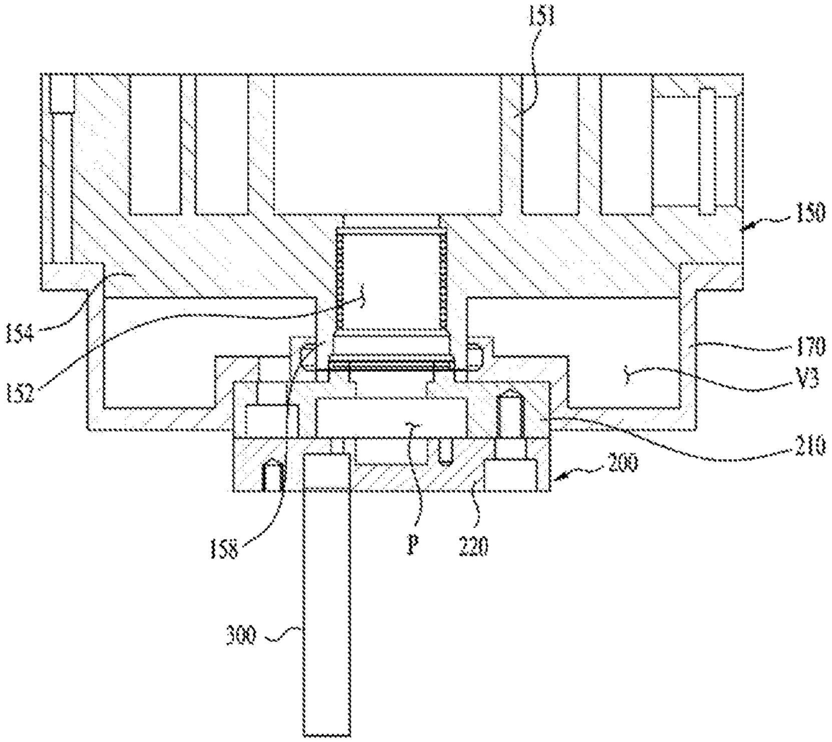

151
150
154
170
V3
152
210
200
158
P
220
300

FIG. 3

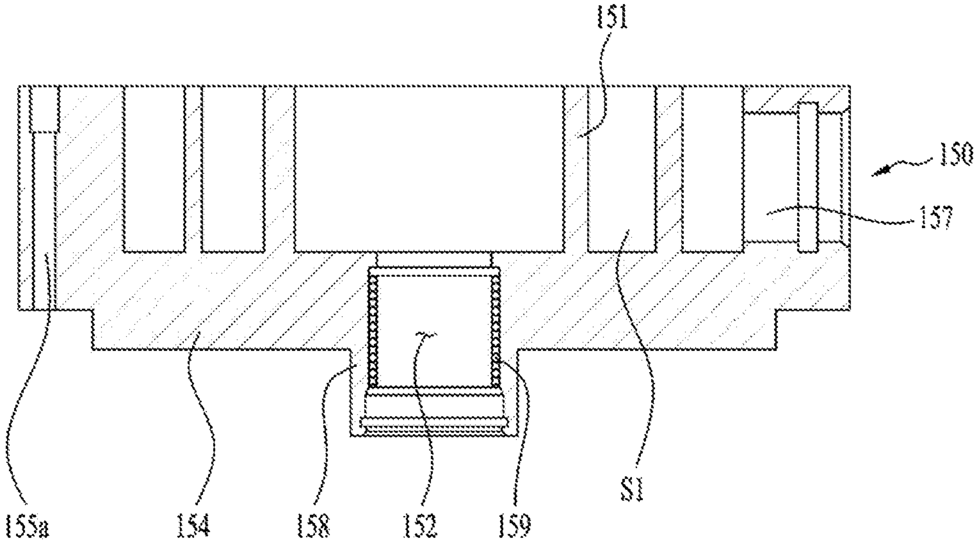

151
150
157
155a
154
158
152
159
S1

FIG. 4

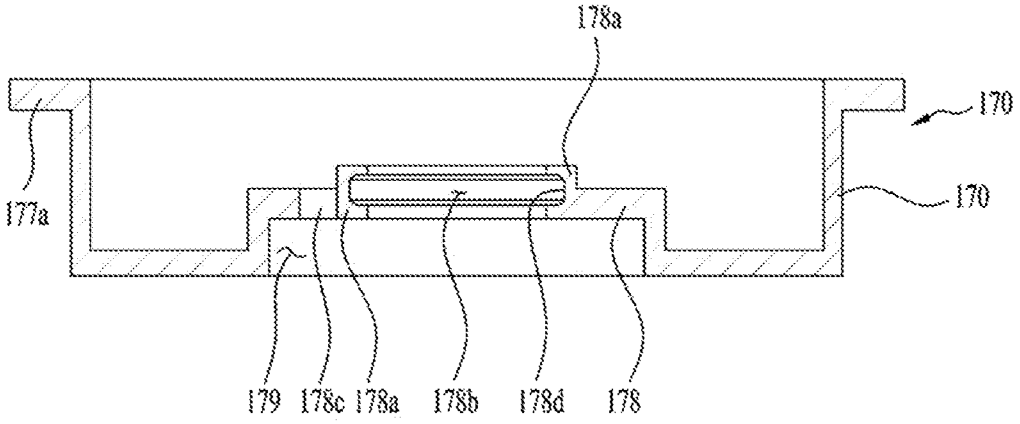

178a
170
177a
170
179
178c
178a
178b
178d
178

FIG. 5

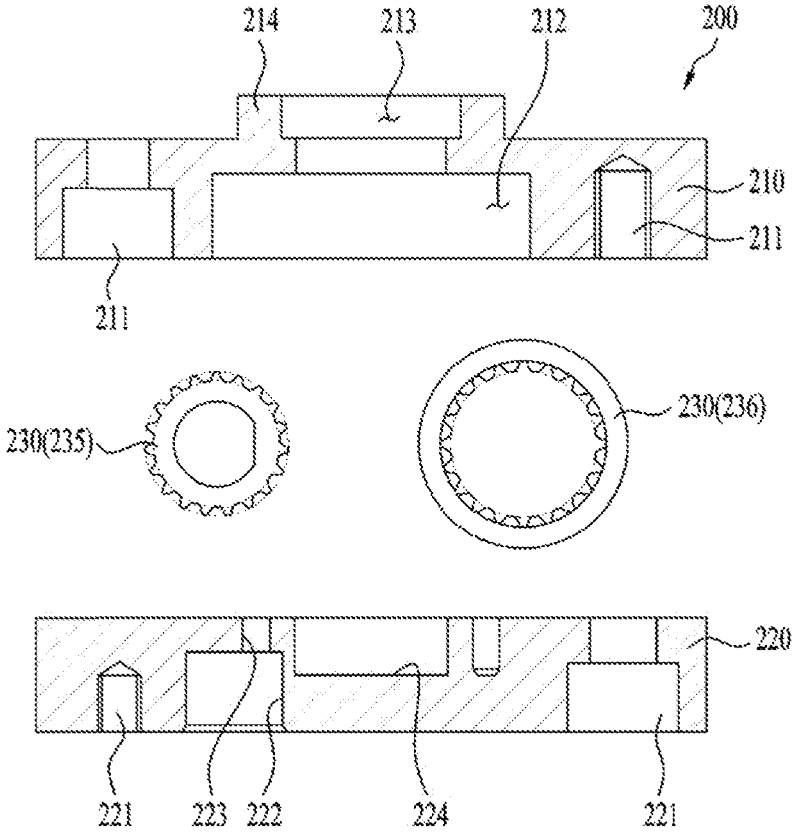
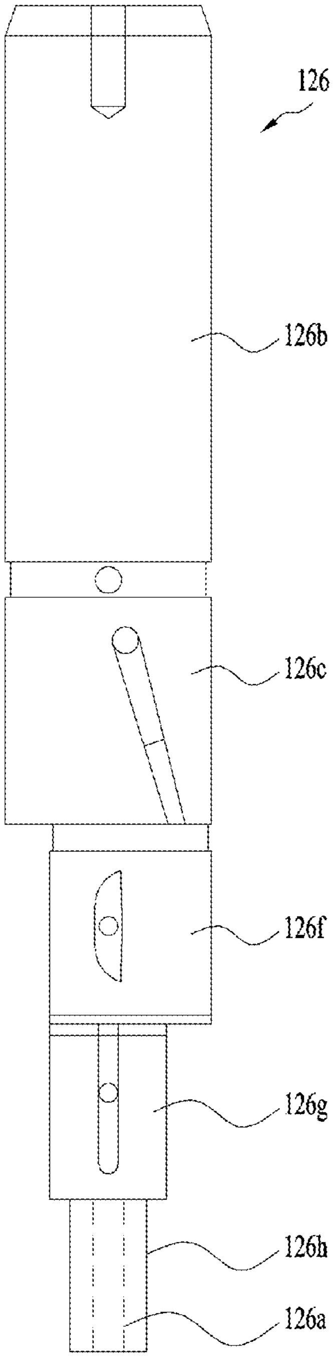

214
213
212
200
210
211
211
230(235)
230(236)
220
221
223
222
224
221

FIG. 6



SCROLL COMPRESSOR OF LOWER COMPRESSION TYPE ENABLING ACTIVE OIL SUPPLY

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of the Korean Patent Application No. 10-2019-0140320 filed on Nov. 5, 2019, the disclosure of which is hereby incorporated by reference as if fully set forth herein.

TECHNICAL FIELD

The present disclosure relates to a compressor, and more particularly, to a compressor that effectively and actively supply oil for lubrication of a compression portion configured to compress a refrigerant.

BACKGROUND

A compressor can be used in, for example, a refrigerator or an air conditioner, to perform a refrigerant compression type cooling cycle (hereinafter, referred to as a cooling cycle).

A compressor can include a reciprocating compressor and a rotary compressor depending on a method of compressing a refrigerant. A rotary compressor can include a scroll compressor.

A scroll compressor can include an upper compression type and a lower compression type depending on positions of a driving motor and a compression portion. The upper compression type of a scroll compressor includes a compression portion that is located above a driving motor. The lower compression type of a scroll compressor includes a compression portion that is located below a driving motor.

That is, a compressor can be referred to as different types depending on relative positions of a driving motor and a compression portion. For example, the compressor can be disposed horizontally rather than vertically. Therefore, the compressor can be referred to as a more generalized term depending on the relative positions of the driving motor and the compression portion. In accordance with a flow direction of a refrigerant inside the compressor and the position of the driving motor, a compressor can be referred to as an upstream compressor where a refrigerant is compressed at an upstream of the driving motor and discharged from a downstream of the driving motor. A compressor can be referred to as a downstream compressor where a refrigerant is compressed at the downstream of the driving motor and discharged from the downstream of the driving motor.

The compressor can include a bearing portion for rotatably supporting a rotary shaft and a compression portion for compressing a refrigerant. Mechanical friction can occur in the bearing portion and the compression portion. An oil can be supplied such that such friction is reduced and the rotary shaft and the compression portion are actively driven. In some instances, active and effective oil supply can continuously be required to reduce the friction and drive the rotary shaft and the compression portion.

In general, an oil can be supplied based on a pressure difference between a high pressure and a low pressure. For example, a pressure difference between a lower low oil space which is a high pressure space in a case and a low pressure space of a compression chamber where a refrigerant is compressed is used. Accordingly, an oil path can be defined between the lower low oil space and the low pressure space of the compression chamber, due to the pressure difference between the lower low oil space and the low pressure space of the compression chamber.

However, where the pressure difference is used for supplying an oil, it can be difficult to continuously maintain effective and active oil supply in a driving area (e.g., a low pressure ratio driving area) that has no significant pressure difference. This can reduce an effective driving area of a compressor, which can extend from a low speed to a high speed. This is because that low speed driving can be limited due to insufficient oil supply. Therefore, a compressor that can provide a wide driving area and enable effective and active oil supply is required.

SUMMARY

The present disclosure relates to a compressor that address the above-mentioned problems.

Some implementations of the present disclosure provide a compressor that solves problems of scroll compressors of the related art.

Some implementations of the present disclosure provide a compressor that enables effective and active oil supply even in a low pressure ratio driving area that does not provide a sufficient pressure difference.

Some implementations of the present disclosure provide a compressor that has a wide driving area through an oil supply based on a pressure difference together with an oil supply using a pump. For example, some implementations of the present disclosure provide a compressor that includes a pump without substantial modifications to components for an oil supply based on a pressure difference.

Some implementations of the present disclosure provide a compressor that includes a pump assembly for oil supply that exactly match a center of the compressor and is fixed at the center.

Additional advantages, objects, and features of the present disclosure will be set forth in the description that follows and will also become apparent to those having ordinary skill in the art based on the following description or the practice of the present disclosure. Other objectives and advantages of the present disclosure can be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

To achieve these objects and other advantages and in accordance with the purpose of the present disclosure, as embodied and broadly described herein, particular implementations of the present disclosure provide a compressor that includes a case, a driving motor, a centrifugation space, a discharge pipe, a rotary shaft, a compression portion, a pump assembly, and an oil pickup. The case defines an oil space. The driving motor includes a stator disposed in the case and a rotor disposed in the stator. The rotor is configured to rotate in the stator. The centrifugation space is defined in the case by a first side of the driving motor and the case, and is configured to permit centrifugation of a compressed refrigerant and a lubricant oil. The discharge pipe is disposed at the case and configured to discharge the refrigerant from the centrifugation space to an exterior of the case. The rotary shaft is coupled to the rotor and configured to rotate based on rotation of the rotor. The rotary shaft defines a first oil supply path. The compression portion is disposed at a second side of the driving motor that is opposite to the first side of the driving motor, wherein the compression portion is configured to compress the refrigerant based on rotation of the rotary shaft. The pump assembly is configured to rotate with the rotary shaft and pump the oil based on the rotation of the pump assembly. The oil pickup defines a second oil supply path between the pump assembly and the oil space of the case.

In some implementations, the compressor can optionally include one or more of the following features. The compression portion may include a muffler that is configured to receive the compressed refrigerant that is discharged from the compression portion. The compression portion may be configured to guide the compressed refrigerant to the discharge pipe. The compression portion may include a fixed scroll and an orbiting scroll that is configured to orbit with respect to the fixed scroll and compress the refrigerant based on orbiting of the orbiting scroll with respect to the fixed scroll. A shaft support portion of the fixed scroll may be disposed at a center of the fixed scroll and receive the rotary shaft through the shaft support portion of the fixed scroll. The shaft support portion of the fixed scroll may include a first boss that protrudes toward the oil space of the case. A pump holder portion may be defined at a center of the muffler and recessed toward the driving motor. The pump assembly may be disposed in the pump holder portion. A shaft support portion of the pump holder portion may be disposed at a center of the pump holder portion and receive the rotary shaft through the shaft support portion of the pump holder portion. The shaft support portion of the pump holder portion may include a second boss that protrudes toward the driving motor. At least a portion of the first boss may be inserted into the second boss. The first boss and the second boss may be at least partially overlapped with each other. The pump assembly may include an oil pump that is connected to the rotary shaft, and pump housings that receive the oil pump. The pump housings includes an upper housing that is inserted into the pump holder portion of the muffler, and a lower housing that is coupled with the upper housing. The upper housing includes a shaft support portion of the upper housing that receives the rotary shaft through the shaft support portion of the upper housing, and a third boss that protrudes toward the driving motor. At least a portion of the third boss may be inserted into the first boss. The first boss and the third boss may be at least partially overlapped with each other. The lower housing may include an end shaft support portion that receives and supports an end of the rotary shaft. A pumping space may be defined between the shaft support portion of the upper housing and the end shaft support portion of the lower housing and receive the oil pump. The lower housing may include a communication portion that fluidly communicates the pumping space with the oil space. The communication portion may include a pickup arrangement groove that receives the oil pickup. The lower housing may include a plurality of coupling holes that are coupled with the upper housing. The rotary shaft may include a motor coupling portion, a main bearing portion, an eccentric portion, a sub bearing portion, and a pump coupling portion. The motor coupling portion may be coupled with the driving motor. The main bearing portion may extend from the motor coupling portion. The eccentric portion may extend from the main bearing portion and is coupled with the orbiting scroll. The sub bearing portion may extend from the eccentric portion. The pump coupling portion may extend from the sub bearing portion and is coupled with the pump assembly. The motor coupling portion, the main bearing portion, the sub bearing portion and the pump coupling portion may be coaxial. The pump coupling portion may have a smaller outer diameter than the motor coupling portion, the main bearing portion, and the sub bearing portion. The pump assembly may include pump housings that have a pumping space that receives an oil pump. An end shaft support portion may be defined abutted to the pumping space inside the pump housings. An oil that is received into the end shaft support portion may be supplied to a first portion that is opposite to the end shaft support portion through the oil supply path of the rotary shaft. The compression portion may include a back pressure chamber that has a pressure lower than the oil supply path. The oil may be supplied to the first portion based on (i) a differential pressure between the oil supply path and the back pressure chamber and (ii) a pumping pressure of the pump assembly

To achieve these objects and other advantages and in accordance with the purpose of the present disclosure, as embodied and broadly described herein, a compressor according to the present disclosure can comprise a case; a driving motor including a stator provided at an inner side of the case and a rotor rotatably provided at an inner side in a radius direction of the stator; a centrifugation space defined inside the case by a downstream side of the driving motor and the case, enabling centrifugation of a compressed refrigerant and a lubricant oil; a discharge pipe provided in the case, discharging the refrigerant inside the centrifugation space to the outside of the case; a rotary shaft rotated by being coupled to the rotor and provided with an oil supply path; a compression portion provided at an upstream side of the driving motor, compressing the refrigerant through rotation of the rotary shaft; a pump assembly provided below the rotary shaft, pumping oil by being rotated in a single body with the rotary shaft; and an oil pickup forming an oil supply path between the pump assembly and a low oil space formed inside the case.

The compression portion can include a muffler accommodating the compressed refrigerant discharged from the compression portion, provided to guide the compressed refrigerant to the discharge pipe.

The compression portion can include a fixed scroll and an orbiting scroll provided to compress the refrigerant through orbiting movement with respect to the fixed scroll.

A shaft support portion in which the rotary shaft is accommodated by passing therethrough can be provided at a center of the fixed scroll, and can include a first boss protruded toward the low oil space.

In some implementations, a pump holder portion recessed toward the driving motor to allow the pump assembly to be arranged therein is formed at a center of the muffler.

A shaft support portion in which the rotary shaft is accommodated by passing therethrough can be provided at a center of the pump holder portion, and can include a second boss protruded toward the driving motor.

In some implementations, at least a portion of the first boss is inserted into the second boss, and therefore the first boss and the second boss are overlapped with each other.

The pump assembly can include an oil pump connected to the rotary shaft and pump housings accommodating the oil pump.

The pump housings can include an upper housing inserted into the pump holder portion of the muffler and a lower housing coupled with the upper housing.

The upper housing can be provided with a shaft support portion in which the rotary shaft is accommodated by passing therethrough, and can include a third boss protruded toward the driving motor.

In some implementations, at least a portion of the third boss is inserted into the first boss, and therefore the first boss and the third boss are overlapped with each other.

In some implementations, the lower housing is provided with an end shaft support portion into which an end of the rotary shaft is inserted and supported.

In some implementations, a pumping space in which the oil pump is arranged is formed between the shaft support portion of the upper housing and the end shaft support portion of the lower housing, and the lower housing is provided with a communication portion for communicating the pumping space with the low oil space.

The communication portion can include a pickup arrangement groove into which the oil pickup is inserted and arranged.

The rotary shaft can include a motor coupling portion coupled with the driving motor; a main bearing portion extended from the motor coupling portion; an eccentric portion extended from the main bearing portion and coupled with the orbiting scroll; a sub bearing portion extended from the eccentric portion; and a pump coupling portion extended from the sub bearing portion and coupled with the pump assembly.

In some implementations, the rotary shaft is formed in a single body with one bar by mechanical processing of one bar.

In some implementations, the motor coupling portion, the main bearing portion, the sub bearing portion and the pump coupling portion have the same shaft, and the pump coupling portion has the smallest outer diameter.

Features of the aforementioned embodiments are complexly applicable to the other embodiments unless contradicted or exclusive.

In accordance with one embodiment of the present disclosure, a compressor, which enables effective and active oil supply even in a low pressure ratio driving area that is lack of a pressure difference, can be provided.

In accordance with one embodiment of the present disclosure, a compressor, in which a pump assembly for oil supply can be provided to be exactly matched with a center and its center can stably be fixed, can be provided.

It is understood that both the foregoing general description and the following detailed description of the present disclosure are exemplary and explanatory and are intended to provide further explanation of the present disclosure as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross sectional view of an example compressor.

FIG. **2** is a cross sectional view of an example pump arrangement structure in the compressor.

FIG. **3** is a cross sectional view of a fixed scroll shown in FIG. **2**.

FIG. **4** is a cross sectional view of a muffler shown in FIG. **2**.

FIG. **5** is an exploded cross sectional view of a pump assembly shown in FIG. **2**.

FIG. **6** illustrates an example rotary shaft in the compressor.

DETAILED DESCRIPTION

Particular implementations of the present disclosure are illustrated herein with reference to the accompanying drawings. Wherever possible, same reference numbers will be used throughout the drawings to refer to the same or like parts.

Referring to FIG. **1**, an example compressor is described in accordance with implementations of the present disclosure.

FIG. **1** is a cross sectional view of an example scroll compressor. Since a compression portion is located below a driving motor, the compressor can be referred to as a lower compression type compressor or an upstream compressor.

For convenience of description, upper and lower positions are determined based on a compressor located vertically. Upstream position or downstream position are determined based on a flow of a refrigerant and a position of a driving motor. In the compressor, an upper position can correspond to a downstream position, and a lower position can correspond to an upstream position.

In some implementations, the compressor can include a case **110**, a driving motor **120**, a compression portion **100**, and a rotary shaft **126**.

The case **110** can define an inner space. For example, a low oil space where an oil is stored can be provided below the case **110**. The low oil space can correspond to a fourth space V**4** which will be described later. That is, the fourth space V**4** can be defined as the low oil space.

A refrigerant discharge pipe **116** for discharging the compressed refrigerant can be provided at the upstream.

For example, the inner space of the case **110** can include a first space V**1** arranged at the upstream of the driving motor **120**, a second space V**2** arranged between the driving motor **120** and the compression portion **100**, a third space V**3** partitioned by a discharge cover **170**, which will be described later, and the fourth space V**4** arranged below the compression portion **100**.

The first space V**1** can provide a space where centrifugation of the compressed refrigerant and lubricant oil is performed. That is, the refrigerant can substantially be discharged to the discharge pipe **116** through centrifugation between the refrigerant and oil before the compressed refrigerant is discharged to the outside of the compressor through the discharge pipe **116**. This centrifugation space V**1** within the case **110** can be defined by a downstream side of the driving motor and the case **110**.

The case **110** can have a cylindrical shape. For example, the case **110** can include a cylindrical shell **111** of which upper and lower ends are opened.

An upper shell **112** can be provided at an upper portion of the cylindrical shell **111**, and a lower shell **114** can be provided at a lower portion of the cylindrical shell **111**. For example, the upper and lower shells **112** and **114** can be coupled to the cylindrical shell **111** by welding, thereby defining an inner space.

The upper shell **112** can be provided with the refrigerant discharge pipe **116**. The refrigerant compressed by the compression portion **100** can be discharged to the outside through the refrigerant discharge pipe **116**. For example, the refrigerant compressed by the compression portion **100** can be discharged to the outside through the refrigerant discharge pipe **116** after passing through the third space V**3**, the second space V**2** and the first space V**1** in order.

An oil separator or oil returning unit that is typically connected with the compressor is not shown in FIG. **1**. This means that the compressor according to implementations of the present disclosure can effectively separate an oil without a separate oil separator.

The lower shell **114** can partition the fourth space V**4** that is a low oil space where an oil can be stored. The fourth space V**4** can be used as an oil chamber for supplying an oil to the compression portion **100** such that the compressor can actively operate.

Also, a refrigerant suction pipe **118** provides a passage for receiving the refrigerant that will be compressed. The refrigerant suction pipe **118** can be disposed at a side of the cylindrical shell **111**. The refrigerant suction pipe **118** can be provided to pass through a compression chamber **S1** along a side of a fixed scroll **150** as described later.

The driving motor **120** can be provided at an inner side of the case **110**. For example, the driving motor **120** can be arranged above the compression portion **100** at the inner side of the case **110**.

The driving motor **120** can include a stator **122** and a rotor **124**. The stator **122** can have a cylindrical shape, for example, and can be fixed to the case **110**. A coil **122***a* can be wound in the stator **122**. Also, a refrigerant path groove **112***a* can be defined between an outer circumferential surface of the rotor **124** and an inner circumferential surface of the stator **122** to allow the refrigerant or oil discharged from the compression portion **100** to pass therethrough. In some implementations, the refrigerant path groove **112***a* can be partitioned by the inner circumferential surface of the stator **122** and the outer circumferential surface of the rotor **124**.

The rotor **124** can be inwardly disposed in a radius direction of the stator **122**, and can generate a rotation power. In some implementations, the rotary shaft **126** can be fitted into the center of the rotor **124** such that the rotor **124** can be rotated together with the rotary shaft **126**. The rotation power generated by the rotor **124** can be transferred to the compression portion **100** through the rotary shaft **126**.

The compression portion **100** can be coupled to the driving motor **120** to compress the refrigerant. The compression portion **100** can be provided to allow the rotary shaft **126** connected to the driving motor **120** to pass therethrough.

The compression portion **100** can include a shaft support portion protruded upwardly and downwardly. The rotary shaft **126** can pass through at least a portion of the shaft support portion. For example, the shaft support portion can include a first shaft support portion upwardly protruded from the compression portion **100** and a second shaft support portion downwardly protruded from the compression portion **100**, which are described herein in more detail.

In some implementations, the compression portion **110** includes a main frame **130**, a fixed scroll **150** and an orbiting scroll **140**.

For example, the compression portion **110** can further include an Oldham's ring **135**. The Oldham's ring **135** can be provided between the orbiting scroll **140** and the main frame **130**. Also, the Oldham's ring **135** can enable orbiting movement of the orbiting scroll **140** on the fixed scroll **150** while preventing rotation of the orbiting scroll **140**.

The main frame **130** can be disposed below the driving motor **120**, and form the upper portion of the compression portion **100**.

The main frame **130** can include a frame end plate **132** (hereinafter, referred to as "first end plate") that generally has a circle shape, a frame shaft support **132***a* (hereinafter, referred to as "first shaft support portion") that is disposed at the center of the first end plate **132** and receives the rotary shaft **126** therethrough, and a frame sidewall **131** (hereinafter, referred to as "first sidewall) that downwardly protrudes from an outer circumference of the first end plate **132**.

An outer circumference of the first sidewall **131** can adjoin the inner circumferential surface of the cylindrical shell **111**, and its lower end can adjoin an upper end of a fixed scroll sidewall **155**, which is described herein in more detail.

The first sidewall **131** can include a frame discharge hole **131***a* constituting a refrigerant passage by passing through the inside of the first sidewall **131** in a shaft direction. An inlet of the frame discharge hole **131***a* can fluidly communicate with an outlet of a fixed scroll discharge hole **155***a*, which is described herein in more detail. An outlet of the frame discharge hole **131***a* can fluidly communicate with the second space **V2**. The frame discharge hole **131***a* and the fixed scroll discharge hole **155***a*, which fluidly communicate with each other, can be referred to as second discharge holes **131***a* and **155***a*.

The frame discharge hole **131***a* can be provided in a plural number along the circumference of the main frame **130**. The fixed scroll discharge hole **155***a* can be provided in a plural number along the circumference of the fixed scroll **150** to correspond to the frame discharge hole **131***a*.

The first shaft support portion **132***a* can protrude from an upper surface of the first end plate **132** to the driving motor **120**. Also, the first shaft support portion **132***a* can be provided with a first bearing that receives and supports a main bearing portion **126***c* of the rotary shaft **126**.

For example, the first shaft support portion **132***a* can rotatably receive and support the main bearing portion **126***c* of the rotary shaft **126**, which constitutes the first shaft support portion. The first shaft support portion **132***a* can be provided at the center of the main frame **130** in a shaft direction to pass through the main frame **130**.

An oil pocket **132***b* can collect an oil that is discharged between the first shaft support portion **132***a* and the rotary shaft **126**. The oil pocket **132***b* can be defined at the upper surface of the first end plate **132**.

The oil pocket **132***b* can be recessed at the upper surface of the first end plate **132**. The oil pocket **132***b* can be defined in a ring shape along the circumference of the first shaft support portion **132***a*. Also, a back pressure chamber **S2** can be defined at the bottom of the main frame **130** to support the orbiting scroll **140** by means of a pressure of a space defined by the fixed scroll **150** and the orbiting scroll **140**.

For example, the back pressure chamber **S2** can include an intermediate pressure area (that is, intermediate pressure chamber). An oil supply path **126***a* that is provided in the rotary shaft **126** can include a high pressure area having a pressure higher than that of the back pressure chamber **S2**. Therefore, an oil can be supplied to each target component through the oil supply path due to a pressure difference between the back pressure chamber and the oil supply path. In some instances, however, such oil supply does not occur as intended because the pressure difference is not sufficient in a low load driving area having low differential pressure. Particular implementations of the present disclosure are described herein that solve this problem.

In order to partition the high pressure area from the intermediate pressure area, a back pressure seal **180** can be provided between the main frame **130** and the orbiting scroll **140**, and can serve as a sealing member, for example.

Also, the main frame **130** can be coupled with the fixed scroll **150** to define a space where the orbiting scroll **140** can pivotally be provided.

The fixed scroll **150** can be provided below the main frame **130**. For example, the fixed scroll **150** constituting a first scroll can be coupled to the bottom of the main frame **130**.

The fixed scroll **150** can include a fixed scroll end plate **132** (hereinafter, referred to as "second end plate") that generally has a circular shape, a fixed scroll sidewall **155** (hereinafter, referred to as "second sidewall") that protrudes from an outer circumference of the second end plate **154** to an upper portion of the second end plate **154**, a fixed wrap **151** that protrudes from the upper surface of the second end plate **154** and is engaged with an orbiting wrap **141** of the orbiting scroll **140** to define a compression chamber S**1**, and a shaft support portion **152** of the fixed scroll **150** (hereinafter, referred to as "second shaft support portion") that is provided at the center of a rear surface of the second end plate **154** to allow the rotary shaft **126** to pass therethrough.

The compression portion **100** can include a first discharge hole **153** for discharging the compressed refrigerant to the discharge cover **170**, and the aforementioned second discharge holes **131***a* and **155***a* that are spaced apart from the first discharge hole **153** outside a radius direction of the compression portion **100** and configured to guide the compressed refrigerant toward the refrigerant discharge pipe **116**.

For example, the second end plate **154** can be provided with the first discharge hole **153** that id defined to guide the compressed refrigerant from the compression chamber S1 to an inner space of the discharge cover **170**. Also, a position of the first discharge hole **153** can optionally be set in consideration of a discharge pressure which is required.

As the first discharge hole **153** is provided toward the lower shell **114**, the discharge cover **170** can be coupled to the bottom of the fixed scroll **150** and guide the refrigerant that is discharged from the compression portion to the fixed scroll discharge hole **155***a*, which is described herein in more detail.

The discharge cover **170** can be sealed in and coupled to the lower end of the compression portion **100**. The discharge cover **170** can guide the refrigerant compressed by the compression portion **100** toward the refrigerant discharge pipe **116**.

For example, the discharge cover **170** can be sealed in and coupled to the bottom of the fixed scroll **150** to separate the discharge path of the refrigerant from the fourth space V**4**.

Also, the discharge cover **170** can be provided with a through hole **176** that is coupled to a sub bearing portion **126***g* of the rotary shaft **126**, which constitutes a second bearing portion. The through hole **176** can allow an oil feeder **171** to pass therethrough. At least a portion of the oil feeder **171** can be immersed in the oil stored in the fourth space V4 of the case **110**.

In some implementations, the second sidewall **155** can be provided with the fixed scroll discharge hole **155***a* constituting the refrigerant passage together with the frame discharge hole **131***a* by passing through the inside of the second sidewall **155** in a shaft direction.

The fixed scroll discharge hole **155***a* can correspond to the frame discharge hole **131***a*, and its inlet can fluidly communicate with the inner space of the discharge cover **170** and its outlet can fluidly communicate with an inlet of the frame discharge hole **131***a*.

The fixed scroll discharge hole **155***a* and the frame discharge hole **131***a* can communicate the third space V**3** with the second space V**2** such that the refrigerant discharged from the compression chamber S1 to the inner space of the discharge cover **170** can be guided to the second space V2.

A refrigerant suction pipe **118** can fluidly communicate with a suction side of the compression chamber S**1** at the second sidewall **155**. Also, the refrigerant suction pipe **118** can be spaced apart from the fixed scroll discharge hole **155***a*.

The second shaft support portion **152** can protrude from the lower surface of the second end plate **154** to the fourth space V**4**. Also, the second shaft support portion **152** can be provided with a second bearing such that a sub bearing **126***g* of the rotary shaft **126** can be inserted into and supported in the second bearing.

The second shaft support portion **152** can be bent toward a shaft center such that its lower end can constitute a thrust bearing by supporting a lower end of the sub bearing portion **126***g* of the rotary shaft **126**.

The orbiting scroll **140** can be arranged between the main frame **130** and the fixed scroll **150** and provide a second scroll.

For example, the orbiting scroll **140** can perform orbiting movement by being coupled to the rotary shaft **126** and define a pair of compression chambers S**1** with the fixed scroll **150**. That is, the compression chambers **S1** can be defined between the orbiting scroll **140** and the fixed scroll **150**.

The orbiting scroll **140** can include an orbiting scroll end plate (hereinafter, referred to as "third end plate") that generally has a circular shape, an orbiting wrap **141** that protrudes from a lower surface of the third end plate **145** and is engaged with the fixed wrap **151**, and a rotary shaft coupling portion **142** that is provided at the center of the third end plate **145** and rotatably coupled to an eccentric portion **126***f* of the rotary shaft **126**.

An outer circumference of the third end plate **145** can be located at an upper end of the second sidewall **155**, and a lower end of the orbiting wrap **141** can be tightly adhered to the upper surface of the second end plate **154** and therefore supported in the fixed scroll **150**.

For example, a pocket groove **185** can be defined on the upper surface of the orbiting scroll **140** and configured for guiding oil discharged through oil holes **128***a*, **128***b*, **128***d*, and **128***e*, which will be described later.

For example, the pocket groove **185** can be recessed on the third end plate **145**. That is, the pocket groove **185** can be defined on the third end plate **145** between the back pressure seal **180** and the rotary shaft **126**.

Also, one or more pocket grooves **185** can be defined at both sides of the rotary shaft **126** as shown. The pocket groove **185** can have a ring shape on the third end plate **145** based on the rotary shaft **126** between the back pressure seal **180** and the rotary shaft **126**.

The outer circumference of the rotary shaft coupling portion **142** is connected to the orbiting wrap **141** and serves to define the compression chamber **S1** together with the fixed wrap **151** during a compression process.

The fixed wrap **151** and the orbiting wrap **141** can have an involute shape. The involute shape may mean a curved line corresponding to a track drawn by an end of a thread wound around a base source having a random radius when the thread is unwound.

Also, the eccentric portion **126***f* of the rotary shaft **126** can be inserted into the rotary shaft coupling portion **142**. The eccentric portion **126***f* inserted into the rotary shaft coupling portion **142** can be overlapped with the orbiting wrap **141** or the fixed wrap **151** in a radius direction of the compressor.

In this case, the radius direction may mean a direction (that is, left and right direction) orthogonal to the shaft direction (that is, up and down direction).

As described above, if the eccentric portion **126***f* of the rotary shaft **126** is overlapped with the orbiting wrap **141** in a radius direction by passing through the third end plate **145**, a repulsive force and a compressive force of the refrigerant can be given to the same plane based on the third end plate **145** and therefore counterbalanced with each other.

Also, the rotary shaft **126** can be coupled to the driving motor **120**, and can include the oil supply path **126***a* for guiding the oil stored in the fourth space V4 that is a low oil space of the case **110**, to the upper portion.

For example, an upper portion of the rotary shaft **126** can be fitted into the center of the rotor **124** such that its lower portion can be coupled to the compression portion **100** and therefore supported in a radius direction.

The rotary shaft **126** can transfer a rotary force of the driving motor **120** to the orbiting scroll **140** of the compression portion **100**. As a result, the orbiting scroll **140** eccentrically coupled to the rotary shaft **126** can perform orbiting movement with respect to the fixed scroll **150**.

The main bearing portion **126***c* can be provided below the rotary shaft **126** and therefore inserted into the first shaft support portion **132***a* of the main frame **130** and supported in a radius direction. Also, the sub bearing portion **126***g* can be provided below the main bearing portion **126***c* and therefore inserted into the second shaft support portion **152** of the fixed scroll **150** and supported in a radius direction. The eccentric portion **126***f* can be provided between the main bearing portion **126***c* and the sub bearing portion **126***g* and therefore inserted into and coupled to the rotary shaft coupling portion **142** of the orbiting scroll **140**.

The main bearing portion **126***c* and the sub bearing portion **126***g* can be provided on the same shaft line to have the same shaft center, and the eccentric portion **126***f* can be provided to be eccentric with respect to the main bearing portion **126***c* or the sub bearing portion **126***g* in a radius direction.

The eccentric portion **126***f* can have an outer diameter smaller than that of the main bearing portion **126***c* and greater than that of the sub bearing portion **126***g*. In this case, the rotary shaft **126** can be coupled to the eccentric portion **126***f* by passing through each of the shaft support portions **132***a* and **152** and the rotary shaft coupling portion **142**.

The oil supply path **126***a* can be defined inside the rotary shaft **126** and configured for supplying the oil in the fourth space V4 that is a low oil space to the outer circumference of each of the bearing portions **126***c* and **126***g* and the outer circumference of the eccentric portion **126***f* The oil holes **128***a*, **128***b*, **128***d* and **128***e* that are configured passing from the oil supply path **126***a* to the outside of a radius direction of the rotary shaft **126** can be defined at the bearing portions **126***c* and **126***g* and the eccentric portion **126***f* of the rotary shaft **126**.

For example, the oil holes can include the first oil hole **128***a*, the second oil hole **128***b*, the third oil hole **128***d*, and the fourth oil hole **128***e*.

The first oil hole **128***a* can pass through the outer circumference of the main bearing portion **126***c*. The first oil hole **128***a* can pass from the oil supply path **126***a* to the outer circumference of the main bearing portion **126***c*.

Also, the first oil hole **128***a* can pass through, but not limited to, an upper portion of the outer circumferential surface of the main bearing portion **126***c*. In implementations where the first oil hole **128***a* includes a plurality of holes, each hole can be defined at the upper portion or the lower portion of the outer circumferential surface of the main bearing portion **126***c*, or can be defined at each of the upper portion and the lower portion of the outer circumferential surface of the main bearing portion **126***c*.

The second oil hole **128***b* can be defined between the main bearing portion **126***c* and the eccentric portion **126***f*. The second oil hole **128***b* can include a plurality of holes in some implementations.

The third oil hole **128***d* can pass through the outer circumferential surface of the eccentric portion **126***f*. For example, the third oil hole **128***d* can pass from the oil supply path **126***a* to the outer circumferential surface of the eccentric portion **126***f*.

The fourth oil hole **128***e* can be defined between the eccentric portion **126***f* and the sub bearing portion **126***g*.

The oil guided to the upper portion through the oil supply path **126***a* can be discharged through the first oil hole **128***a* and then supplied to the outer circumferential surface of the main bearing portion **126***c*.

Also, the oil guided to the upper portion through the oil supply path **126***a* can be discharged through the second oil hole **128***b* and then supplied to the upper surface of the orbiting scroll **140**, and can be discharged through the third oil hole **128***d* and then supplied to the outer circumferential surface of the eccentric portion **126***f*.

Also, the oil guided to the upper portion through the oil supply path **126***a* can be discharged through the fourth oil hole **128***e* and then supplied to the outer circumferential surface of the sub bearing portion **126***g* or between the orbiting scroll **140** and the fixed scroll **150**.

The oil feeder **171** for pumping the oil stored in the fourth space V4 can be coupled to the lower end of the rotary shaft **126**, that is, the lower end of the sub bearing portion **126***g*. The oil feeder **171** can supply the oil stored in the fourth space V4 to the aforementioned oil holes **128***a*, **128***b*, **128***d* and **128***e*.

The oil feeder **171** can include an oil supply pipe **173** that is inserted into the oil supply path **126***a* of the rotary shaft **126** and coupled to the oil supply path **126***a*, and an oil suction member **174** that is inserted into the oil supply pipe **173** and configured to suction the oil.

The oil supply pipe **173** can be immersed in the fourth space V4 by passing through the through hole **176** of the discharge cover **170**, and the oil suction member **174** can serve as a propeller.

The oil suction member **174** can define a spiral groove **174***a* that extends along a length direction of the oil suction member **174**. The spiral groove **174***a* can be defined in the circumference of the oil suction member **174**, and can be extended toward the aforementioned oil holes **128***a*, **128***b*, **128***d* and **128***e*.

When the oil feeder **171** is rotated together with the rotary shaft **126**, the oil stored in the fourth space V4 can be guided to the oil holes **128***a*, **128***b*, **128***d* and **128***e* along the spiral groove **174***a*.

A balance weight **127** for restraining noise vibration can be coupled to the rotor **124** or the rotary shaft **126**. The balance weight **127** can be provided in the second space V2 between the driving motor **120** and the compression portion **100**.

An example process of operating the scroll compressor according to implementations of the present disclosure will be described hereinafter.

When a power source is applied to the driving motor **120** to generate a rotational force, the rotary shaft **126** coupled to the rotor **124** of the driving motor **120** is rotated. Then, while the orbiting scroll **140** that is eccentrically coupled to the rotary shaft **126** orbits with respect to the fixed scroll **150**, the compression chamber **S1** is defined between the orbiting wrap **141** and the fixed wrap **151**. The compression chamber **S1** can be defined in various steps with a volume narrower toward a center direction.

Then, the refrigerant supplied from the outside of the case **110** through the refrigerant suction pipe **118** can directly enter the compression chamber **S1**. This refrigerant can be compressed while moving toward a discharge chamber of the compression chamber **S1** in accordance with orbiting movement of the orbiting scroll **140** and then discharged to the third space V**3** through the first discharge hole **153** of the fixed scroll **150**.

Afterwards, the compressed refrigerant discharged to the third space V**3** has been discharged to the inner space of the case **110** through the fixed scroll discharge hole **155***a* and the frame discharge hole **131***a* and then discharged to the outside of the case **110** through the refrigerant discharge pipe **116**. These operations can be repeated.

While the compressor is being driven, the oil stored in the fourth space V**4** can be guided to the upper portion through the rotary shaft **126** and then actively supplied to the bearing portion, that is, bearing surface through the plurality of oil holes **128***a*, **128***b*, **128***d* and **128***e*, whereby the bearing portion can be prevented from being worn out.

Also, the oil discharged through the plurality of oil holes **128***a*, **128***b*, **128***d* and **128***e* can form an oil film between the fixed scroll **150** and the orbiting scroll **140** to maintain an airtight state in the compression portion.

For this reason, the oil can be mixed with the refrigerant compressed in the compression portion **100** and then discharged to the first discharge hole **153**. Hereinafter, for convenience of description, the refrigerant mixed with the oil may be referred to as an oil mixture refrigerant.

The oil mixture refrigerant is guided to the first space V**1** by passing through the second discharge holes **131***a* and **155***a*, the second space V**2** and the refrigerant path groove **112***a*. The refrigerant of the oil mixture refrigerant guided to the first space V**1** can be discharged to the outside of the compressor through the refrigerant discharge pipe **116** and the other oil can return to the fourth space V**4** through an oil returning path **112***b*.

For example, the oil returning path **112***b* can be arranged at the outmost in a radius direction inside the case **110**. For example, the oil returning path **112***b* can include a path between the outer circumferential surface of the stator **122** and the inner circumferential surface of the cylindrical shell **111**, a path between the outer circumferential surface of the main frame **130** and the inner circumferential surface of the cylindrical shell **111**, and a path between the outer circumferential surface of the fixed scroll **150** and the inner circumferential surface of the cylindrical shell **111**.

In some implementations, since the discharge cover **170** is coupled to the lower end of the compression portion **100**, a fine gap can exist between the lower end of the compression portion **100** and the upper end of the discharge cover **170**. This fine gap may be a cause of refrigerant leakage.

That is, when the refrigerant is discharged to the third space V**3** through the first discharge hole **153** of the compression portion **100** and then guided to the second discharge holes **131***a* and **155***a*, the refrigerant may leak out to the gap that may exist between the compression portion **100** and the discharge cover **170**.

Also, leakage of the refrigerant may deteriorate compression efficiency of the compressor. This problem can be solved through sealing members provided between the compression portion **100** and the discharge cover **170** (a coupling portion of the compression portion **100** and the discharge cover **170**) and a coupling structure of the compression portion **100** and the discharge cover **170**.

The compressor according to implementations of the present disclosure has been described as above. Particularly, particular implementations of the scroll compressor has been described, which uses a differential pressure for supplying an oil.

Hereinafter, implementations of a compressor are described that include an oil pump for supplying an oil, along with the aforementioned oil supply structure based on the differential pressure.

In these implementations, the oil pump **230** (see FIG. **5**) is provided using the discharge cover or the muffler **170** and the fixed scroll **150**, which are shown in FIG. **1**. That is, the oil pump **230** can additionally be arranged, and shapes of the rotary shaft **126**, the muffler **170** and the fixed scroll **150** can be modified for arrangement of the oil pump **230**. Also, an oil pickup **300** can be added for supplying the oil. The oil pickup can be the same as or similar to the oil feeder **171** that includes the oil supply pipe **173** or the oil suction member **174** shown in FIG. **1**.

FIG. **2** illustrates a cross section of the fixed scroll **150**, the muffler **170** and an pump assembly **200** that are coupled to one another. FIG. **3** illustrates a cross section of the fixed scroll **150** shown in FIG. **2**, and FIG. **4** illustrates a cross section of the muffler **170** shown in FIG. **2**. FIG. **5** illustrates an exploded cross section of the oil pump assembly **200** shown in FIG. **2**.

The fixed scroll **150** and the muffler **170** can be coupled to each other by assembly. Both the fixed scroll **150** and the muffler **170** can be fixed with robustness by such assembly coupling. Particularly, based on the muffler **170**, the muffler **170** and the fixed scroll **150** can be coupled to each other by assembly at the outside in a radius direction of the muffler **170**.

In addition, the muffler **170** and the pump assembly **200** can be coupled to each other by assembly. The pump assembly **200** can include pump housings **210** and **220** forming an external appearance and accommodating the oil pump **230** therein. At least a portion of the pump housings **210** and **220** can be inserted into the muffler **170**, whereby the pump housings **210** and **220** and the muffler **170** can be coupled to each other.

For example, the pump housings **210** and **220** can include an upper housing **210** and a lower housing **220**, which can be coupled to each other. An inner space P can be defined by coupling of the pump housings **210** and **220**, and can be a space for accommodating the oil pump and at the same time can be a temporary low oil space to which oil is supplied.

At least a portion of the upper housing **210** can be inserted into the muffler **170**. Forward and backward movement and left and right movement of the pump housings **210** and **220** are restricted by such insertion coupling. The pump housings **210** and **220** can stably be fixed and coupled to the muffler by bolt or screw coupling. Rotation of the pump housings **210** and **220** is restricted by such bolt or screw coupling. The center of the muffler **170** can match (or be aligned with) the center of the pump assembly **220** by such a coupling structure, and such matching can stably be maintained.

Also, the fixed scroll **150** and the pump housings **210** and **220** can be coupled to each other by assembly. Some component of the pump housings **210** and **220** can be coupled to the fixed scroll **150** by being inserted into the fixed scroll **150**. For example, the fixed scroll **150** and the pump housings **210** and **220** can be coupled to each other such that the center of the pump housings **210** and **220** can match (or be aligned with) the center of the fixed scroll **150**.

Although not shown in FIG. **2**, the rotary shaft **126** (see FIG. **1** and FIG. **6**) that passes through the fixed scroll **150** up and down passes through the muffler **170** up and down and partially passes through the pump housings **210** and **220**. That is, after the rotary shaft **126** passes through the fixed scroll **150**, the muffler **170** and the upper housing **210** in order, the lower end of the rotary shaft **126**, that is, the lower end is located inside the lower housing **220**.

The lower portion of the rotary shaft **126** can be regarded as a driving shaft that drives the oil pump **230** as described later. Therefore, concentricity of the rotary shaft **126** can stably be maintained and at the same time rotation can be performed. For this reason, it is preferable that the fixed scroll **150**, the muffler **170** and the upper housing **210** surround the rotary shaft **126**.

In this case, the pump assembly **200** is provided at the lower end of the rotary shaft **126** and can pump oil by means of a driving force of the rotary shaft and at the same time rotatably support the rotary shaft.

An oil pickup **300** that defines an oil supply path can be provided between the low oil space V4 (see FIG. **1**) and the pump assembly **200**.

The coupling relation among the fixed scroll **150**, the muffler **170** and the pink assembly **200** will be described in more detail.

The shaft support portion **152** that accommodates the rotary shaft **126** can be provided at the center of the fixed scroll **150**, and can include a first boss **158** protruded toward the low oil space V**4**.

The first boss **158** can protrude from the second end plate **154** to the lower portion. Therefore, the fixed scroll **150** surrounds the rotary shaft **126** as much as a length obtained by adding a thickness of the second end plate **154** to a thickness of the first boss **158**. That is, an area supporting the rotary shaft **126** is increased.

The first boss **158** can be provided in a hollow cylindrical shape, and a sub bearing can be provided inside the first boss **158** and the shaft support portion **152**. That is, the sub bearing portion **126*g*** of the rotary shaft **126** shown in FIG. **6** can rotatably be supported by the shaft support portion **152**.

The muffler **170** can include a vessel shaped body **177**, and the body **177** can have a cylindrical vessel shape of which diameter is greater than a height. A flange **177*a*** for assembling with the fixed scroll **150** can be provided at the outside in a radius direction above the body **177** of the muffler **170**, and the muffler **170** can be coupled to the fixed scroll **150** below the fixed scroll **150** through bolt or screw coupling to the flange **177*a***.

A pump holder portion **178** can be provided at the inner side in a radius direction of the muffler body **177**. The pump holder portion **178** can have a shape uplifted from the center of the muffler body **177**. In other words, a space **179** where the pump is arranged can be defined by the pump holder portion **178**. This space **179** can be defined by the muffler body **177** of which center is recessed toward the driving motor **120**.

Therefore, the pump holder portion **178** can define a cylindrical shaped recess space, and this recess space can define a space for pump arrangement.

A shaft support portion **178*b*** of the pump holder portion **178** for allowing the rotary shaft **126** to pass therethrough up and down can be provided at the center of the pump holder portion **178**, and can include a second boss **178*a*** that protrudes toward the driving motor **120**.

The second boss **178*a*** can be provided in a hollow shape to accommodate the first boss **158** of the fixed scroll **150** therein. Therefore, the muffler **170** can be coupled to the fixed scroll **150** by assembly at the outside in a radius direction and coupled to the fixed scroll **150** by assembly at the inner side in a radius direction. Also, since the first boss **158** and the second boss **178*a*** are overlapped with each other at a certain distance, their up and down or left and right movement can be restricted, whereby they can stably be coupled to each other.

An insertion depth of the first boss **158** is increased due to a protruded shape of the second boss **178*a***. That is, the insertion depth of the first boss becomes greater than the thickness of the pump holder portion **178**.

An O-ring groove **178*d*** can be defined at an inner side of the second boss **178*a***. The first boss **158** is inserted through an inner hollow hole of the second boss **178*a***. Therefore, leakage of oil or leakage of the compressed refrigerant, which is unwanted, may occur at the outside in a radius direction of the first boss **158**. Therefore, this leakage can previously be avoided through O-ring.

The protruded shape of the second boss **178*a*** can maintain concentricity among the muffler **170**, the fixed scroll **150** and the rotary shaft **126** as well as secure the O-ring arrangement length and the insertion length of the first boss **158**.

In some implementations, a plurality of coupling holes **178*c*** can be defined in the pump holder portion **178**. A coupling hole **211** can be defined even in the upper housing **210** of the pump assembly **200**. The muffler **170** and the upper housing **210** can be coupled to each other through the coupling holes **178*c*** and **211**.

In other words, after the upper housing **210** is jointed to the pump holder portion **178**, the lower housing **220** can be jointed to the upper housing **210**. Therefore, the coupling holes **211** and **211** for bolt, rivet or screw coupling can be defined in the upper housing **210** and the lower housing **220**. For this reason, a plurality of coupling holes for jointing the pump holder portion **178** and a plurality of coupling holes for arranging the lower housing **220** can be provided in the upper housing **210**. These coupling holes can be spaced apart from each other along a circumferential direction.

A shaft support portion **213** of the upper housing **210** for allowing the rotary shaft **126** to pass therethrough can be provided in the upper housing **210** of the pump assembly **200**, and can include a third boss **214** protruded toward the driving motor.

The third boss **214** can protrude from the upper surface of the upper housing **210** to the lower portion, and the protruded portion can be inserted into the first boss **158**. That is, the third boss **214** can be assembled into the cylindrical hollow hole of the first boss **158**. Therefore, as the first boss **158** and the third boss **214** are overlapped with each other at a certain distance, their coupling and concentricity can stably be maintained.

Finally, according to the implementations, the second boss **178*a*** of the muffler **170**, the first boss **158** of the fixed scroll **150** and the third boss **214** of the pump assembly **200** are located to be overlapped with one another from an outer side to an inner side in a radius direction. The rotary shaft **126** can pass through the center of these bosses and then be supported. Therefore, concentricity of the rotary shaft **126** and concentricity of these bosses can match (or be aligned with) each other and then stably be maintained.

A certain space is defined below the third boss **214** of the upper housing **210**. The oil pump **230** is located in this space. This space can be referred to as a pumping space P (pumping space) or temporary low oil space **212**.

The lower housing **220** can be coupled to the upper housing **210** at the lower portion of the upper housing **210**. The pumping space P can substantially be sealed by this coupling.

An end shaft support portion **224** into which an end of the rotary shaft **126** is inserted and supported can be provided in the lower housing **220**. Therefore, the end of the rotary shaft **126** is located in inner spaces of the pump housings **210** and **220** without being exposed to the low oil space V**4**. The end shaft support portion **224** surrounds the lower end of the rotary shaft **126**. Therefore, the end shaft support portion **224** contributes to maintaining concentricity of the rotary shaft **126**.

In some implementations, oil should be pumped into the pumping space P. The oil is located inside the low oil space V**4**. To this end, a communication portion **223** for communicating the pumping space P with the low oil space V**4** is provided. The communication portion can be provided in the lower housing **220**.

In some implementations, a component for solving an oil level difference between the pumping space P and the low oil space V**4** is provided because the pumping space P is located to be higher than a normal oil level. To this end, the oil pickup **300** can be provided in the lower housing **220**.

The oil pickup **300** can have a pipe shape, and can be inserted into the lower portion of the lower housing **220**. To this end, an oil pickup arrangement groove **222** can be defined in the lower housing **220**. The oil pickup arrangement groove **222** can fluidly communicate with the communication portion **223**. Therefore, the oil entering through oil pickup **300** can enter the pumping space P by passing through the communication portion **223**.

The oil pump **230** is a pump provided inside the aforementioned pumping space P, and can be embodied in various types. A trochoid pump is shown in FIG. **5** as an example. Instead of the trochoid pump, a gear pump can be provided.

The oil pump **230** can include an outer gear **236** and an inner gear **235**. The inner gear **235** is inserted into a center portion of the outer gear **236** and then rotated. The inner gear **235** can be assembled into a pump coupling portion **126***h* which is a lower end of the rotary shaft **126**. Therefore, the inner gear **235** can be rotated through rotation of the rotary shaft **126**.

The inner gear **235** can eccentrically be rotated with respect to the outer gear **236**. That is, the rotary shaft **126** and the inner gear **235** can be coupled to each other to have eccentricity. The number of teeth of the outer gear **236** can be more than the number of teeth of the inner gear **235** by 1 or more. As the inner gear **235** is eccentrically rotated, the oil is pumped from the outside of the oil pump **230**, and the pumped oil can be discharged to the outside after entering the oil pump **230**.

To this end, a hollow hole **126***a* to which the oil can be discharged can be defined in the rotary shaft **126**, especially the pump coupling portion **126***h*. The hollow hole **126***a* can extend to the upper portion of the rotary shaft **126**. In some implementations, the hollow hole **126***a* can more extend to an upper side of the main bearing portion **126***c* of the rotary shaft **126**, referring to FIGS. **1** and **6**. The hollow hole **126***a* passes through the rotary shaft **126** to supply oil to components such as bearing.

As shown in FIG. **6**, the rotary shaft **126** can include a motor coupling portion **126***b*, a main bearing portion **126***c*, an eccentric portion **126***f*, a sub bearing portion **126***g* and a pump coupling portion **126***h*. In some implementations, the pump coupling portion **126***h* can additionally be provided, as compared with the implementations that the oil pump **230** is not provided.

In this case, the pump coupling portion **126***h* does not need to support a force greater than the other portion of the rotary shaft **126** and can have a relatively small diameter and height. Therefore, the pump coupling portion **126***h* imposes less effect on load and strength of the design of the rotary shaft **126**. As a result, since the pump coupling portion **126***h* can simply be added to the rotary shaft **126**, it can be easy to design and manufacture a new rotary shaft.

In some implementations, the end shaft support portion **224** provided in the pump housings **210** and **220** is located below the pumping space P. Therefore, the end shaft support portion **224** can be regarded as a space where oil is filled earlier than the pumping space P. In other words, if the pump is not driven, the oil is stored in the end shaft support portion **224**.

The oil can continuously be supplied through the end shaft support portion **224**. That is, this is because a hollow portion at a lower end of the pump coupling portion **126***h* provided in the end shaft support portion **224** starts from the end shaft support portion **224**. Since oil pumping always starts from the space where oil is stored, continuous and stable oil supply can be performed.

The end shaft support portion **224** surrounds the lower end of the rotary shaft **126**. Therefore, the end shaft support portion **224** contributes to maintaining concentricity of the rotary shaft **126**.

According to the aforementioned implementations, in the compressor where a refrigerant is compressed at the upstream of the driving motor, it is possible to ensure reliability of oil supply in a driving area of low load/low pressure ratio while enlarging a driving area of the compressor. That is, a differential pressure can additionally be generated by driving of the oil pump in an area of low pressure ratio where a differential pressure source is insufficient. Also, concentricity of the oil pump and the rotary shaft can be maintained effectively and stably.

Further, according to these implementations, it is noted that oil can be supplied twice as much as oil supply based on a differential pressure. That is, the amount of oil supply can be increased.

However, when the amount of oil supply is increased, the amount of oil recovery can be reduced. However, as described above, since centrifugation can be performed at the upper side of the driving motor by the driving motor, the compressor where lower compression and upper centrifugation are performed enables effective oil separation and recovery.

It will be apparent to those skilled in the art that the present disclosure can be embodied in other specific forms without departing from the spirit and essential characteristics of the invention. Thus, the above embodiments are to be considered in all respects as illustrative and not restrictive. The scope of the invention should be determined by reasonable interpretation of the appended claims and all change which comes within the equivalent scope of the invention are included in the scope of the invention.

What is claimed is:

1. A compressor comprising: a case that defines an oil space; a driving motor that includes a stator disposed in the case and a rotor disposed in the stator, wherein the rotor is configured to rotate in the stator; a centrifugation space that is defined in the case by a first side of the driving motor and the case, and that is configured to permit centrifugation of a compressed refrigerant and a lubricant oil; a discharge pipe that is disposed at the case and configured to discharge the refrigerant from the centrifugation space to an exterior of the case; a rotary shaft that is coupled to the rotor and configured to rotate based on rotation of the rotor, wherein the rotary shaft defines a first oil supply path; a compression portion that is disposed at a second side of the driving motor that is opposite to the first side of the driving motor, wherein the compression portion is configured to compress the refrigerant based on rotation of the rotary shaft; a muffler that is configured to receive the compressed refrigerant that is discharged from the compression portion, wherein the compression portion being configured to guide the compressed refrigerant to the discharge pipe; a pump assembly that is configured to rotate with the rotary shaft and pump the oil based on the rotation of the pump assembly; and an oil pickup that defines a second oil supply path between the pump assembly and the oil space of the case, wherein the pump assembly includes: an oil pump that is connected to the rotary shaft, and pump housings that receive the oil pump, wherein a pump holder portion is defined at a center of the muffler and recessed toward the driving motor, and wherein the pump assembly is disposed in the pump holder portion, wherein the pump housing includes: an upper housing that is inserted into the pump holder portion of the muffler, and a lower housing that is coupled with the upper housing, and wherein the upper housing includes a shaft support portion of the upper housing that receives the rotary shaft through the shaft support portion of the upper housing; and a third boss that protrudes toward the driving motor.

2. The compressor of claim **1**, wherein the compression portion further includes a fixed scroll and an orbiting scroll that is configured to orbit with respect to the fixed scroll and compress the refrigerant based on orbiting of the orbiting scroll with respect to the fixed scroll.

3. The compressor of claim **2**, wherein the shaft support portion of the fixed scroll is disposed at a center of the fixed scroll and receives the rotary shaft through the shaft support portion of the fixed scroll, and wherein the shaft support portion of the fixed scroll includes a first boss that protrudes toward the oil space of the case.

4. The compressor of claim **3**, wherein a shaft support portion of the pump holder portion is disposed at a center of the pump holder portion and receives the rotary shaft through the shaft support portion of the pump holder portion, and wherein the shaft support portion of the pump holder portion includes a second boss that protrudes toward the driving motor.

5. The compressor of claim **4**, wherein at least a portion of the first boss is inserted into the second boss, and wherein the first boss and the second boss are at least partially overlapped with each other.

6. The compressor of claim **3**, wherein at least a portion of the third boss is inserted into the first boss, and wherein the first boss and the third boss are at least partially overlapped with each other.

7. The compressor of claim **6**, wherein the lower housing includes an end shaft support portion that receives and supports an end of the rotary shaft.

8. The compressor of claim **7**, wherein a pumping space is defined between the shaft support portion of the upper housing and the end shaft support portion of the lower housing and receives the oil pump, and

wherein the lower housing includes a communication portion that fluidly communicates the pumping space with the oil space.

9. The compressor of claim **8**, wherein the communication portion includes a pickup arrangement groove that receives the oil pickup.

10. The compressor of claim **8**, wherein the lower housing includes a plurality of coupling holes that are coupled with the upper housing.

11. The compressor of claim **2**, wherein the rotary shaft includes:

a motor coupling portion that is coupled with the driving motor;

a main bearing portion that extends from the motor coupling portion;

an eccentric portion that extends from the main bearing portion and is coupled with the orbiting scroll;

a sub bearing portion that extends from the eccentric portion; and

a pump coupling portion that extends from the sub bearing portion and is coupled with the pump assembly.

12. The compressor of claim **11**, wherein the motor coupling portion, the main bearing portion, the sub bearing portion and the pump coupling portion are coaxial, and wherein the pump coupling portion has a smaller outer diameter than the motor coupling portion, the main bearing portion, and the sub bearing portion.

13. The compressor of claim **11**, wherein the pump assembly includes pump housings that have a pumping space that receives the oil pump, and

wherein an end shaft support portion is defined abutted to the pumping space inside the pump housings.

14. The compressor of claim **13**, wherein an oil that is received into the end shaft support portion is supplied to an upper portion of the rotary shaft through the first oil supply path of the rotary shaft.

15. The compressor of claim **14**, wherein the compression portion includes a back pressure chamber that has a pressure lower than the first oil supply path, and

wherein the oil is supplied to the upper portion based on (i) a differential pressure between the first oil supply path and the back pressure chamber and (ii) a pumping pressure of the pump assembly.

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